Plan for HCAL Calibration/Monitoring

By HCAL/JetMET group

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General Plan

Following procedure described in HCAL TDR. (sk's talk on 26-Sep-2000)

- http://home.fnal.gov/~kunori/cms/meetings/000926-cmsweek/shuichi/hcal-calib-0009.ppt

Three (+) Tasks

- HCAL Calibration
- Synchronization (?)
- Monitoring on those through life of exp.

\+ Jet/MET energy scale

Calibration & Monitoring Group in HCAL/JetMET group

- Group leader- Olga Kodolova

Data Flow

>>> front end <<<

Scint. Lights
->Tile->Fiber1&2->OptCable
->HPD->Amp->ADC
Charge (for 5-10xings)
HTR (ch) ->(L1Path)
->(DAQPath)

>>> L1Path <<<

E_T(L1Primitive: 8bits:non-linear)
->L1 LUT (ch)
E_T(4x4 HcTower: 8bits:linear)
->L1Calo
E_T(L1jets),Et(L1tau),Et(L1MET)
->L1CaloGlobal(Threshold (obj))
->L1Global
L1Trigger

>>> after DAQPath <<<

->ReadoutAnalyzer (ch)
E_T(channel)
->TowerCreator
E_T(Ec+Hc Tower)
->Jet/MET/tauReco
E_T(jetR),Et(tauR),Et(METR)
->EtCaloCorrection (obj)
(corr. for linearlity)
E_T(JetC),Et(tauC),Et(METC)
->EtPhysCorrection (obj)
(corr. for out-of-cone)
E_T(Parton)

Calibration/correction
(ch) - channel by channel
(obj) - phys. Obj, (jet, tau, MET)

Tools

A) Megatile scanner:
- Co^{60} gamma source
- each tile: light yield
- during construction
  - all tiles

B) Moving radio active source:
- Co^{60} gamma source
- full chain: gain
- during CMS-open (manual)
  - all tiles
- during off beam time (remote)
  - tiles in layer 0 & 9

C) UV Laser:
- full chain: timing, gain-change
- during off beam time
  - tiles in layer 0 & 9
  - all RBX

D) Blue LED:
- timing, gain change
- during the off beam time
  - all RBX

E) Test beam
- normalization between
  - GeV vs. ADC vs. A,B,C,D
- ratios: elec/pion, muon/pion
- pulse shape/time structure
- before assembly
  - a few wedges

F) Physics events
- mip signal, link to HO
  - muon
- calo energy scale (e/pi)
  - charged hadron
- physics energy scale
  - photon+jet balancing
  - Z+jet balancing
  - di-jets balancing
  - di-jet mass
    - W->jj in top decay

>> non-linear response

>> pile-up effect

Scenario (HB/HE)

(same to HF)

1) Before megatile insertion

- megatile scanner: all tiles
- moving wire source: all tiles

2.1) After megatile insertion

- moving wire source: all tiles / 2 layer
- UV laser: 2 layers/wedge

2.2) After megatile insertion

- test beam: a few wedges.

→ Absolute calib. Accuracy of 2% for single particle

3) Before closing the CMS

- moving wire source: all tiles
- UV laser & blue LED: all RBX

(do 3, about once/year)

4) Beam off times

- moving wire source: 2layer/wedge
- UV laser: 2 layer/wedge
- UV laser & blue LED: all RBX

→ Monitor for change with time Accuracy < 1%

5) Beam on (in situ)

- jets / tau / MET ECAL+HCAL

once/year

a few times/day (?)

Scenario toward final ET scale

A) No special event trigger during beam on. (except for monitor runs)

B) Min-bias and QCD events will be used to monitor the calorimeter through runs.

C) Four steps to determine E_T scale after the first run starts.

1. Test beam data and wire source (plus MC) gives initial scale.
2. In 1~3 months, improved E_T scale by physics events.
   - requires very intensive data analyses.
     How soon data will be available for analyses?
     How soon ECAL and MUON/TRACKER will give us calibrated E_T?
3. Development of algorithm for more improved E_T scale.
   - use of full shower shape, i.e. transverse shower shape in ECAL crystals as well as longitudinal shower shape.
   - use of tracks.
     How easy to access to full detector information?
4. Apply the new algorithm for final results.
   - re-processing (some) events
     How easy to reprocess events?

Tasks / Groups

Calibration Tasks

- Defining data
- Defining repository/database
- Collecting data
- Checking quality of data
- Production of calibration coefficient
- Define/implement ORCA interface
- Verify calibration

Three groups are involved.

- JetMET C & M group
- DCS group
- Hardware groups (+ ECAL, Tracker)

JetMET C&M Organization (O.Kodolova)

Test Beam and initial energy scale
- Requirement for beam test / analysis / source

Response equalization (Uniformity)
- Source/min-bias events

Time Dependence
- Source/min-bias/laser/LED

Data collection and maintenance
- Data type / Data format / file system / database

Software Tools
- ORCA Interface

JetMET energy scale
- MC study / In-situ calibration

Synchronization

A.Gribushin
H.Budd
(HE) (HO)

A.Krokhotine
K.Teplov
???

A.Yershov
(HB) (HE)
(HO)

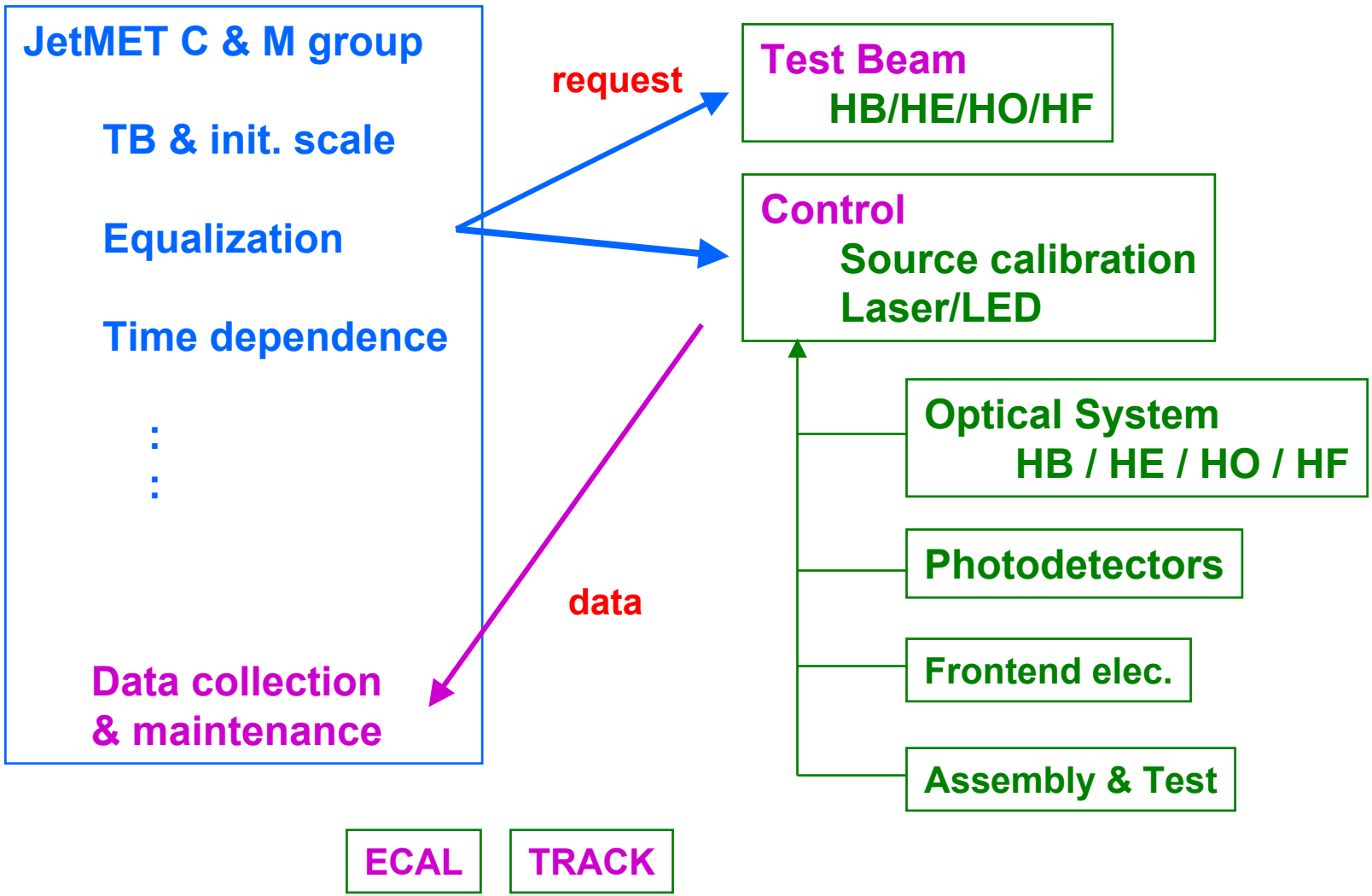
A.Oulianov
T.Kramer

A.Oulianov
S.Abdullin

I.Vardanyan
A.Kokhotine
P.Hidas
V.Konnopianikov
…

???

Relation to Other Groups



Short Term Plan

26-Sep-01 (Wed) 11:00-12:30

- A.Oulianov – Proposition on HCAL database
- T.Kramer – HCAL calibration web page
- P.deBarbaro – Data from bld 186

CPT Week (5-9. Nov'01)

- Decision on organization and more planning
- Discussion on
  - Requirements for Test Beam
  - Define data type / repository

CMS Week (5 Dec'01)

- Continuation of discussion

CMS Week (Mar'02)

→ Decision on above

Need.

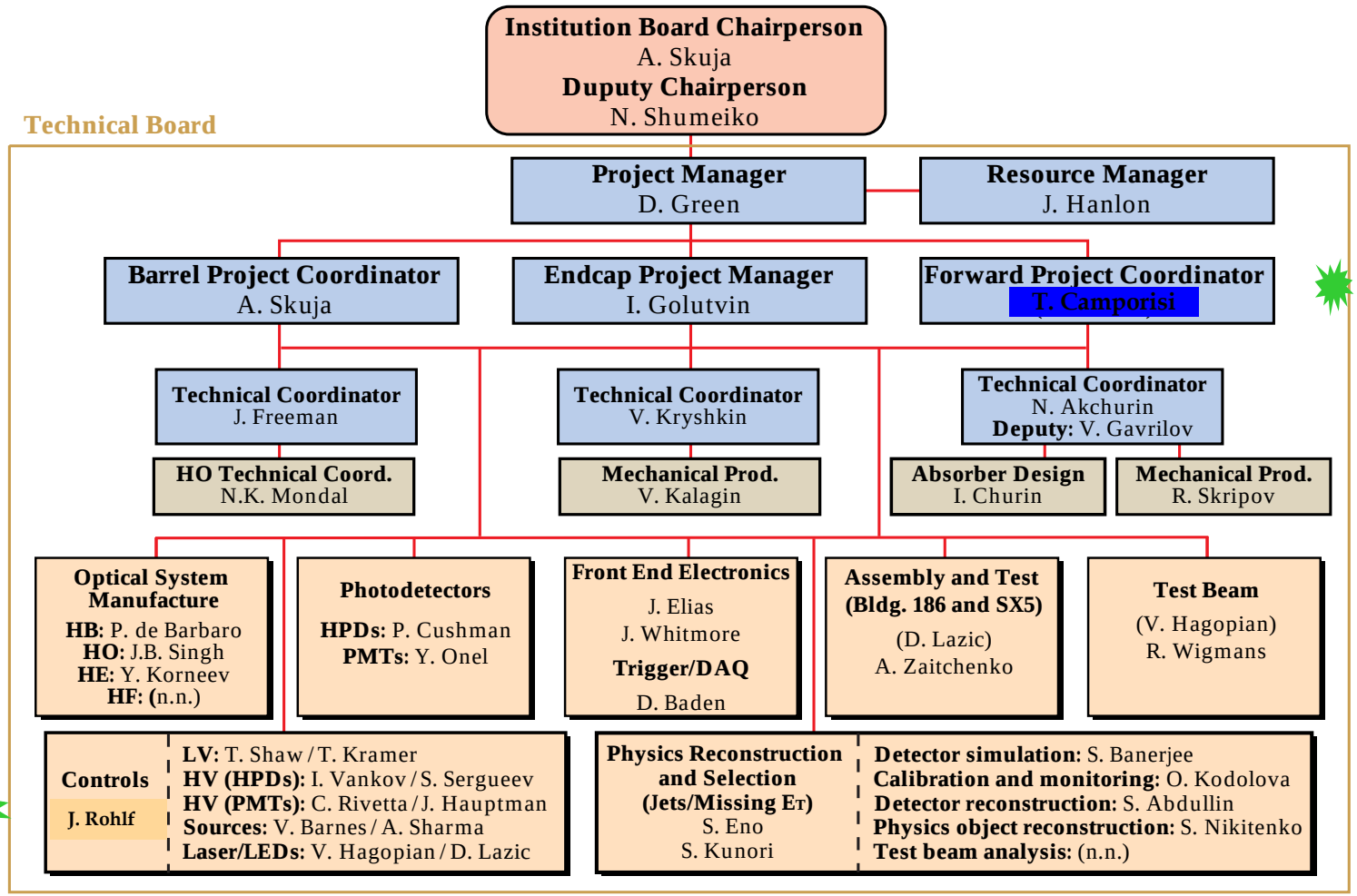
Good test beam data

- **Final Electronics**
  - → measure time structure
- **Low energy.**
- **ECAL**
- **B-field**
  - → hadron shower physics

Additional slides

HCAL Organization

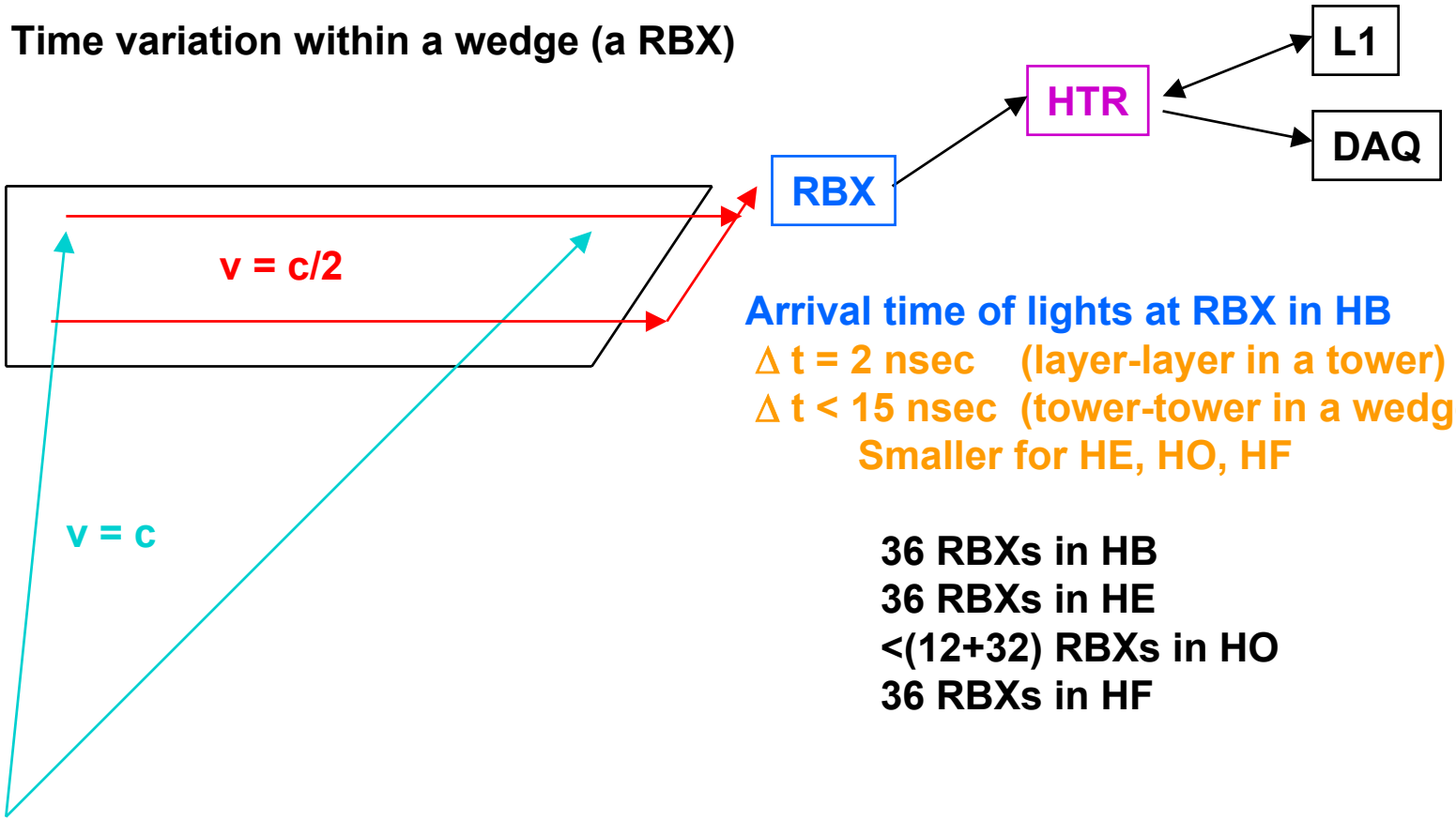
HCAL Project



6 March 2001: Draft 30 Jan 01

HCAL Timing Calibration

1) Time variation within a wedge (a RBX)



Arrival time of lights at RBX in HB

$\Delta t = 2$ nsec (layer-layer in a tower)

$\Delta t < 15$ nsec (tower-tower in a wedge)

Smaller for HE, HO, HF

36 RBXs in HB
36 RBXs in HE
<(12+32) RBXs in HO
36 RBXs in HF

2) Synchronization (global)

L1 data, L1 accept (pointer to pipeline), 40MHz clock

Synchronization (Global)

Correction for variation in

- Data cable length
- TTC distribution

Adjustable knobs

- QIE (1ns step)
- HTR timing to L1 regional crate
- L1 accept pointer to pipeline

Use trigger 1 crossing after the abort gap.

- read out all channels, 10 times/channel
- histograming to find right bucket
- adjust L1 pointer to correct bucket.

about O(weeks) to check all channels at 10E32